NATIONAL BUREAU OF STANDARDS REPORT

8548

PERFORMANCE TEST OF THE "GLASSAIRE"
GLASS FIBER AUTOMATIC RENEWABLE FILTER MEDIA

manufactured by
Air Filter Sales and Service Co.
of Detroit, Mich.

by

Joseph C. Davis and Paul R. Achenbach

to
Public Buildings Service
General Services Administration
Washington, D.C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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* NBS Group, Joint Institute for Laboratory Astrophysics at the University of Colorado.
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1. Introduction

At the request of the Public Buildings Service, General Services Administration, the performance characteristics of the "Glassaire" glass fiber roll-type filter media, manufactured by the Air Filter Sales and Service Co. of Detroit, Michigan, were determined. The scope of the investigation included the determination of the arrestance of Cottrell precipitate diffused into the laboratory air, and the dust-holding capacity when the face velocity was maintained at 500 ft/min. and while the media was intermittently advanced with a maximum setting for the pressure drop across the media of 0.5 in. W.G.

2. Description of Test Specimen

The roll of media was supplied for test purposes by the Air Filter Sales and Service Co. of Detroit, Michigan. The glass fiber media, according to the manufacturer, had been purchased from the American Air Filter Co. and had been treated with tricresylphosphate in the jell form. The media was white in color and was 36 in. wide by 65 ft. long and was nominally 2 in. thick. A high density backing was bonded to the downstream side of the material to provide a relatively high tensile strength and to minimize breakage of the media on the roll during service. Microscopic examination of the fibers in the main body indicated that they were between 4 and 7 microns in diameter. Their length ranged from 3 to 8 in. Microscopic examination of the fibers in the higher density backing indicated that they were between 4 and 20 microns in diameter. Their length ranged from about 5 in. to about 12 in. The approximate unit weight was 37 g/ft^2. The results of an infrared analysis showed that the adhesive was tricresylphosphate as claimed by the manufacturer.

After the test had been performed, an evaluation was made of the unit weight of the tricresylphosphate in the media. Three determinations were made with the use of a Soxlett Extractor with absolute

grade ethyl alcohol as the solvent. For each determination, a sample of the media, 2 x 6 in. in area, was used. A white flocculent material which precipitated out during the process was removed by filtering through No. 41 Whatman filter paper. An average of the three determinations for unit weight of tricresylphosphate was 21 g/ft^2.

3. Test Methods and Procedure

The medium was tested at a net face velocity of 500 ft/min. The arrestance determinations were made with the "NBS Dust Spot Method for Air Filters" (ASHVE Transactions, Vol. 44, p. 379, 1938). For the test, the roll of media was installed in a roll-filter frame constructed to fit the NBS test apparatus. This apparatus provided an air-tight enclosure and adapters to fit the upstream and downstream sections of the test duct. This roll-filter frame has been used previously for testing various media of this type.

The frame had two openings, 2 ft x 2 ft, one upstream and the other downstream from the filter. The roll of filter media was placed at the top of the frame on a spool and arranged so the media passed immediately behind the downstream opening as it unrolled. The expended media was rolled up on a similar spool at the bottom of the frame. The bottom spool was driven by a motor actuated by a manually operated switch when the pressure drop across the media reached o.5 in. W.G. Nine vertical bars in the downstream opening served to prevent appreciable deflection of the media under the influence of the air pressure difference. The edges of the media were supported in metal channels to restrict by-pass of air between the media and frame.

The frame and Glassaire media were installed in the dust spot test apparatus and carefully sealed to prevent any by-pass of air or inward flow into the test apparatus, except through the measuring orifice. After establishing the correct air flow rate through the filter, samples of air were drawn from the center points of the test duct two feet upstream and eight feet downstream of the test specimen at equal rates and passed through known area of Whatman No. 41 filter paper. The arrestance determinations were made with Cottrell precipitate injected into the air stream at a ratio of one gram per 1,000 cu. ft. of air.

The light transmission of the sampling papers was measured before and after the test on the same area of each paper, and the two sampling papers used for any one arrestance determination were selected to have the same light transmission when clean.

For determining the arrestance of the filter, different size areas of sampling paper were exposed upstream and downstream of the filter in order to obtain a similar increase of opacity on the two

sampling papers. The arrestance was calculated by the formula:

$$A = \left(1 - \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta U}\right) \times 100$$

where the symbols S_U and S_D are the upstream and downstream sampling areas and ΔU and ΔD are the observed changes in the opacity of the upstream and downstream sampling papers, respectively.

Arrestance determinations were made when the media was clean at the beginning of the test, and at selected intervals of loading until the intermittent advance of the media became representative of a steady state operation. The arrestance determinations were made with Cottrell precipitate only, while cotton linters were added during the loading process in a ratio of 4 parts to every 96 parts of Cottrell precipitate, including the Cottrell precipitate used for arrestance measurements. The Cottrell precipitate had been previously sifted through a 100-mesh screen and the lint was prepared by grinding No. 7 cotton linters through a Wiley mill with a 4-millimeter screen.

The advance of the filter media was observed through a window in the test apparatus by determining the position of a marker, attached to the mat, relative to a yardstick mounted in the filter housing, adjacent to the mat. A pilot light connected in parallel with the electric motor enabled the operator to note the position of the media and to record the pressure drop across the medium at the beginning and at the end of each advance cycle. The advance cycle, actuated by the manually operated switch, was initiated when the pressure drop across the filter reached approximately 0.50 in. W.G. and was stopped when the drop was about 0.454 in. W.G.

The position of the media at the beginning of each advance cycle was recorded as well as the corresponding cumulative dust load at the time of advance. From this information a plot was made of the advance of the media Vs. dust load, and when the relation between the two parameters became very nearly linear, ten more determinations of advance as related to load were made. The dust-holding capacity in grams/ft^2 was then determined by drawing the best-fitting straight line through the last eleven determinations.

The pressure drop across the media was recorded at the beginning of the test, after each arrestance determination, after introduction of each 20-gram increment of Cottrell precipitate and lint into the test duct, and at the beginning and end of each advance cycle.

4. Test Results

The test results obtained on the "Glassaire" media at the air flow rate of 2000 cfm are summarized in Tables 1 and 2.

TABLE 1

Performance of the "Glassaire" Roll Filter Media
At an Air Flow Rate of 2000 CFM

Cumulative Dust Load	Total Advance of Media	Pressure Drop	Arrestance*
grams	inches	in. W.G.	per cent
0	0	0.162	74.2
1236	23.25	0.452	84.1
1406	28.50	0.454	84.2
1489	31.00	0.504	86.9
1489	31.00	0.452	84.5
1631	35.50	0.500	85.0
1698	37.25	0.504	85.1
1698	37.25	0.542	84.2
1761	39.25	0.450	85.0

*Cottrell precipitate in the laboratory air

It will be noted that the arrestance of the clean filter media was 74.2 percent and the average arrestance under steady-state conditions was 84.9% using Cottrell precipitate in the laboratory air as the aerosol.

TABLE 2

Dust Load, Mat Travel, and Pressure Drop
of "Glassaire" Glass Fiber Media

Dust Load grams	Mat Travel inches		Pressure Drop, In. W.G.	
	Advance	Total	After Advance	Before Advance
0	0	0	.162	--
1007	--	17.25	.453	.502
1090	2.25	19.50	.456	.502
1153	2.25	21.75	.450	.504
1236	1.50	23.25	.452	.498
1319	2.50	25.75	.450	.506
1406	2.75	28.50	.454	.502
1489	2.50	31.00	.452	.504
1568	2.00	33.00	.454	.504
1631	2.50	35.50	.470	.500
1698	1.75	37.25	.452	.504
1761	2.00	39.25	.450	.504

The first movement of the media was approximately 4 inches and occurred with a dust load of 522 grams and at a pressure drop of 0.530 in. W.G. Steady-state conditions were indicated when the media had advanced 17.25 in. and when the dust load was 1007 grams. The pressure drop at this point was 0.453 in. W.G. Under steady-state conditions the pressure drop before advance ranged from 0.498 to 0.504 in. W.G. with an average 0.503 in. W.G., and after advance the pressure drop ranged from 0.450 to 0.470 in. W.G. with an average of 0.45 in. W.G.

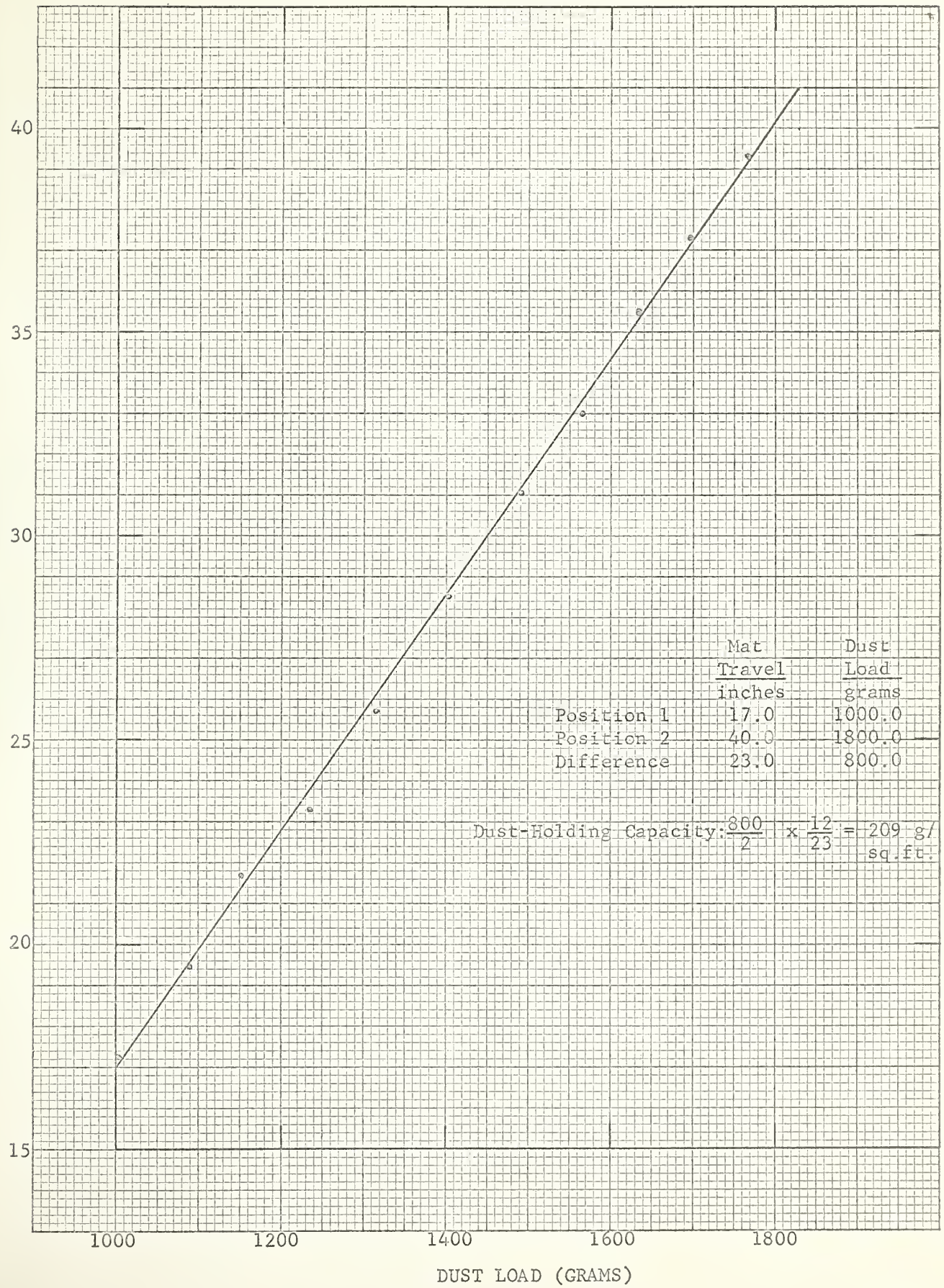
The graph of Figure 1 shows the performance of the media for the 11 observations taken after steady-state observations were established. It will be noted that some of the individual points of

observation do not lie exactly on the straight line. These deviations occurred partly because the advance distance could be observed on the scale only to the nearest quarter-inch mark, and because the manually-operated switch was not opened or closed at exactly the same respective pressure drop each time. Based on the best-fitted straight line through the observed data in Figure 1, it is shown that after 17 inches of mat travel, the dust load was 1000 grams, and after 40 in. of travel, the dust load was 1800 grams. Thus, a mat travel of 23 inches was caused by the introduction of 800 grams of dust. The dust-holding capacity of the media was calculated by dividing the dust load increment by the total advance in feet during the corresponding loading period and by the width of the media.

$$\text{Dust-holding capacity} = \frac{800}{2} \times \frac{12}{23} = 209 \text{ g/sq ft}$$

The average performance values determined for the test specimen were 84.9 percent arrestance and 209 g/sq ft dust-holding capacity. The current requirements specified for the Type E media are 75 percent average arrestance and 200 g/sq ft dust-holding capacity using Cottrell precipitate as the test dust.

MAT TRAVEL VERSUS DUST LOAD
AIR FILTER SALES AND SERVICE CO.
RENEWABLE FILTER MEDIA



	Mat Travel inches	Dust Load grams
Position 1	17.0	1000.0
Position 2	40.0	1800.0
Difference	23.0	800.0

Dust-Holding Capacity: $\frac{800}{2} \times \frac{12}{23} = 209$ g/sq.ft.

Figure 1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